

## CLAIMS

1. A method for producing a sample for processing or analysis including the following steps:

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a) introducing the sample into a mixing chamber containing a suspension fluid, where the sample is either in solid form or is in liquid form immiscible with the suspension fluid, so that the sample moves from an inlet to an outlet of the mixing chamber; and

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b) introducing one or more reagents into the mixing chamber, where the one or more reagents are either in solid form or are in liquid form immiscible with the suspension fluid, so that each of the reagents move from the inlet and contact the sample at a location in the mixing chamber before the sample reaches the outlet of the mixing chamber;

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where the location of contact between the sample and the one or more reagents in the mixing chamber is predetermined by predetermining the rate of movement of the sample and of each reagent, and where the sample mixes with the one or more reagents upon contact to form a processed sample for further processing or analysis.

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2. A method as claimed in claim 1 where the rate of movement of the sample and of each reagent in the suspension fluid of known density is predetermined by selecting the size and density of the sample and/or the size and density of each reagent:

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3. A method as claimed in claim 1 or claim 2 where the rate of movement of the sample and the rates of movement of each reagent are such that the sample contacts and mixes with each reagent as it moves in the mixing chamber.

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4. A method as claimed in any one of claims 1 to 3 where the mixing chamber has a tapered portion to assist contact of the sample with each reagent by causing the sample and each reagent to converge as they move in the mixing chamber.
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5. A method as claimed in any one of claims 1 to 4 where the sample contacts and mixes with a single reagent in the mixing chamber.
6. A method as claimed in any one of claims 1 to 5 where the sample contacts and mixes with two or more reagents in the mixing chamber.
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7. A method as claimed in claim 6 where the two or more reagents contact and mix with the sample at substantially the same time.
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8. A method as claimed in claim 6 where the rates of movement of the sample and of each of the two reagents are predetermined so that the sample contacts and mixes with a first reagent and then contacts and mixes with a second reagent, and optionally with further reagents successively.
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9. A method as claimed in any one of claims 1 to 8 where the mixing chamber is orientated vertically.
10. A method as claimed in claim 9 where the sample and the one or more reagents are introduced at or near to the top of the mixing chamber and descend in the suspension fluid.
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11. A method as claimed in claim 9 where the sample and the one or more reagents are introduced at or near to the bottom of the mixing chamber and ascend in the suspension fluid.

12. A method as claimed in any one of claims 1 to 11 where the sample is an extract from a biological sample selected from the group including blood, serum, semen, saliva, urine, and milk.
- 5 13. A method as claimed in any one of claims 1 to 11 where the sample is an extract obtained from meat, fat, bone, hair, skin, faeces, plant material or a microbial habitat.
- 10 14. A method as claimed in any one of claims 1 to 11 where the sample is a non-biological sample selected from the group including water from waterways, industrial wastes, and hazardous or non-hazardous chemicals, including radioactive materials.
- 15 15. A method as claimed in any one of claims 1 to 14 where the one or more reagents are selected from the group including Tris buffer, water, magnesium chloride, an oligonucleotide, a DNA template, a deoxyribonucleoside triphosphate, and a thermostable DNA polymerase.
- 20 16. A method as claimed in any one of claims 1 to 15 where the suspension fluid is a hydrocarbon oil.
17. A method as claimed in claim 16 where the hydrocarbon oil is paraffin.
- 25 18. A method as claimed in any one of claims 1 to 17 where the introduction of the one or more reagents is controlled by detecting the introduction of the sample and sending a signal to a device controlling the introduction of the one or more reagents.
- 30 19. A method as claimed in any one of claims 1 to 18 where the flow rate of suspension fluid through the mixing chamber is regulated.

20. A method as claimed in any one of claims 1 to 19 where the suspension fluid is introduced into the mixing chamber to maintain a constant level of the suspension fluid within the mixing chamber.
- 5 21. A method as claimed in any one of claims 1 to 20 where the sample is in liquid form immiscible in the suspension fluid.
22. A method as claimed in any one of claims 1 to 20 where the sample is in solid form.
- 10 23. A method as claimed in claim 22 where the sample is a coated magnetised bead or a lyophilised mass of solid.
- 15 24. An apparatus for carrying out the method of any one of claims 1 to 23 including:
- a) a mixing chamber;
  - 20 b) one or more inlets for introducing a suspension fluid into the mixing chamber;
  - c) one or more inlets for introducing a sample for processing or analysis into the mixing chamber;
  - 25 d) one or more inlets for introducing one or more reagents into the chamber; and
  - e) an outlet to enable a processed sample to exit the mixing chamber.
- 30 25. An apparatus as claimed in claim 24 further including a device downstream of the outlet for analysing the processed sample.

26. An apparatus as claimed in claim 25 where the device is a PCR thermocycler, a spectrophotometer, a fluorescence detector, an incubator or reaction chamber, a chemiluminescence detector, a bioluminescence detector, a scintillation counter, a diverter, a sorter, or a fraction collector.
27. An apparatus as claimed in any one of claims 24 to 26 further including a second mixing chamber connected in series to a first mixing chamber.
28. An apparatus as claimed in any one of claims 24 to 27 further including a detector to detect the introduction of the sample and a device to receive a signal from the detector where the device controls the introduction of the one or more reagents.
29. An apparatus as claimed in any one of claims 24 to 28 further including a detector to detect the level of the suspension fluid and a device to receive a signal from the detector where the device controls the introduction of the suspension fluid to maintain a constant level.
30. An apparatus as claimed in any one of claims 24 to 29 where the mixing chamber is closed to the atmosphere and the mixing chamber is under a positive pressure to assist the flow of the suspension fluid from the suspension fluid inlet to the outlet.
31. An apparatus as claimed in any one of claims 24 to 29 where the mixing chamber is open to the atmosphere and a negative pressure is applied to the outlet of the apparatus to assist the flow of the suspension fluid from the suspension fluid inlet to the outlet.

32. An apparatus as claimed in any one of claims 24 to 31 where the outlet is integrally formed with an outlet conduit having a bore diameter in the range of 50  $\mu\text{m}$  to 10 mm.
- 5 33. An apparatus as claimed in any one of claims 24 to 31 where the outlet is an opening adapted for connection to an outlet conduit having a bore diameter in the range of 50  $\mu\text{m}$  to 10 mm.
- 10 34. An apparatus as claimed in any one of claims 24 to 33 further including a coaxial injector having an inner bore from which the sample or each reagent is introduced into the mixing chamber and an outer layer containing suspension fluid where suspension fluid flows from the outer layer into the mixing chamber in a manner which assists each sample or reagent to move from the end of the inlet into the mixing chamber.
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